

IN THE CLAIMS:

Please cancel Claims 9, 14, 27 and 42 without prejudice or disclaimer of the subject matter recited therein.

Please amend Claims 1, 10-13, 15-26, 28, 30 and 40, and add Claims 47-58 as follows:

1. (Currently Amended) A projection optical system for projecting an image of an object onto an image plane, comprising:

a first imaging optical system for forming an intermediate image of the object, said first imaging optical system including (i) a first lens unit having a positive power, (ii) a first optical unit having a first mirror for reflecting and collecting abaxial light from the object, (iii) a second optical unit having a second mirror for reflecting light from said first mirror to the image plane side, with which the abaxial light is caused to pass an outside of an effective diameter of said first mirror, and (iv) a second lens unit having a negative power and being disposed between said first and second mirrors ~~a first mirror for reflecting and collecting abaxial light from the object, and a refractive lens having a positive refractive power;~~

a second imaging optical system for re-imaging the image upon the image plane; and

a field optical system disposed between said first imaging optical system and said second imaging optical system, for projecting a pupil of said first imaging optical system onto said second imaging optical system, said field optical system including a first

field mirror unit having a first field mirror, a second field mirror unit having a second field mirror, and one positive lens disposed adjacent the image plane side of said first mirror.

~~a second mirror for reflecting light from said first mirror to the image plane side, whereby the abaxial light is caused to pass outside of an effective diameter of said first mirror; and~~

~~a lens group having a negative refractive power and being disposed between said first and second mirrors and between said first mirror and said refractive lens.~~

2. (Original) A projection optical system according to Claim 1, wherein said first imaging optical system has a magnification β which satisfies a relation $|\beta| \geq 1$.

Claims 3-9. (Cancelled).

10. (Currently Amended) A projection optical system according to Claim 9 1, wherein said second imaging optical system is constituted by lenses only and has a positive refracting power.

11. (Currently Amended) A projection optical system according to Claim 9 1, wherein said second imaging optical system has a magnification BG2 which satisfies a relation $-0.5 < BG2 < -0.05$.

12. (Currently Amended) A projection optical system according to Claim 9
1, wherein said first imaging optical system has a magnification BG1 which satisfies a relation
 $-40.0 < BG1 < -0.5$.

13. (Currently Amended) A projection optical system according to Claim 9
1, wherein said field optical system is all constituted by lenses.

14. (Cancelled).

15. (Currently Amended) A projection optical system according to Claim
14 1, wherein said first field mirror comprises a concave mirror and wherein said second field
mirror comprises a convex mirror.

16. (Currently Amended) A projection optical system for projecting an
image of an object onto an image plane, comprising: according to Claim 14,
a first imaging optical system for forming an intermediate image of the
object, said first imaging optical system including (1) a first lens unit having a positive power,
(ii) a first optical unit having a first mirror for reflecting and collecting abaxial light from the
object, (iii) a second optical unit having a second mirror for reflecting light from said first mirror
to the image plane side, with which the abaxial light is caused to pass an outside of an effective
diameter of said first mirror, and (iv) a second lens unit having a negative power and being
disposed between said first and second mirrors;

a second imaging optical system for re-imaging the intermediate image upon the image plane; and

a field optical system disposed between said first imaging optical system and said second imaging optical system, for projecting a pupil of said first imaging optical system onto said second imaging optical system, said field optical system including a wherein said first field mirror unit having a first field mirror comprises with a concave mirror surface, and wherein said a second field mirror comprises unit having a second field mirror with a concave mirror surface.

17. (Currently Amended) A projection optical system according to Claim 9 1, wherein relations $P1 < 0$ and $Pf+P2 > 0$ are satisfied where $P1$, Pf and $P2$ are Petzval sums of said first imaging optical system, said field optical system and said second imaging optical system, respectively.

18. (Currently Amended) A projection optical system according to Claim 9 1, wherein a relation $0.6 < e/LM1 < 2.5$ is satisfied where $LM1$ is a paraxial distance between the object and said first mirror, and e is a distance from the object to a pupil conjugate point defined by an optical element positioned at the object side of said first mirror.

19. (Currently Amended) A projection optical system according to Claim 9 1, wherein the distance $LM1$ satisfies a relation $0.5 < OIL/(LM1 + 2xLM2) < 20$, where $LM2$ is a paraxial distance between said first and second mirrors, and OIL is a paraxial distance along the optical path, from the object to the image defined by said first imaging optical system, wherein

LM1 is a paraxial distance between the object and said first mirror, and LM2 is a paraxial distance between said first and second mirrors.

20. (Currently Amended) A projection optical system according to Claim 9 1, wherein the distances LM1 and LM2 satisfy a relation $0.2 < LM2/LM1 < 0.95$, wherein LM1 is a paraxial distance between the object and said first mirror, and LM2 is a paraxial distance between said first and second mirrors.

21. (Currently Amended) A projection optical system according to Claim 9 1, wherein the distance LM1 satisfies a relation $0.15 < LM1/L < 0.55$, where L is a distance from an object plane to an image plane in said projection optical system, wherein LM1 is a paraxial distance between the object and said first mirror, and LM2 is a paraxial distance between said first and second mirrors.

22. (Currently Amended) A projection optical system for projecting an image of an object onto an image plane, comprising: according to Claim 9;
a first imaging optical system for forming an intermediate image of the object, said first imaging optical system including (i) a first lens unit having a positive power, (ii) a first optical unit having a first mirror for reflecting and collecting abaxial light from the object, (iii) a second optical unit having a second mirror for reflecting light from said first mirror to the image plane side, with which the abaxial light is caused to pass an outside of an effective diameter of said first mirror, and (iv) a second lens unit having a negative power and being disposed between said first and second mirrors;

a second imaging optical system for re-imaging the intermediate image upon the image plane; and

a field optical system disposed between said first imaging optical system and said second imaging optical system, for projecting a pupil of said first imaging optical system onto said second imaging optical system, said field optical system including a first field mirror unit having a first field mirror, and a second field mirror unit having a second field mirror,

wherein said first ~~mirror-group~~ optical unit has a magnification BGM1, which satisfies a relation ~~$-2.0 < 1/BGM1 < 0.4$~~ $-1.2 < 1/BGM1 < 0.4$.

23. (Currently Amended) A projection optical system according to Claim 9 1, wherein said first imaging optical system has a lens group having a positive refracting power and disposed closest to the object side of said projection optical system.

24. (Currently Amended) A projection optical system according to Claim 9 1, wherein said first ~~mirror-group~~ optical unit includes a lens of negative refracting power and said first mirror.

25. (Currently Amended) A projection optical system according to Claim 9 1, wherein said second ~~mirror-group~~ optical unit includes ~~said second mirror and~~ a lens.

26. (Currently Amended) A projection optical system according to Claim 9
1, wherein the abaxial light from the object passes through a lens of said second ~~mirror group~~
optical unit before it is incident on said first ~~mirror group~~ optical unit.

27. (Cancelled).

28. (Currently Amended) A projection optical system for projecting an
image of an object onto an image plane, comprising: according to Claim 14;

a first imaging optical system for forming an intermediate image of the
object, said first imaging optical system including (i) a first lens unit having a positive power, (ii)
a first optical unit having a first mirror for reflecting and collecting abaxial light from the object,
(iii) a second optical unit having a second mirror for reflecting light from said first mirror to the
image plane side, with which the abaxial light is caused to pass an outside of an effective
diameter of said first mirror, and (iv) a second lens unit having a negative power and being
disposed between said first and second mirrors;

a second imaging optical system for re-imaging the intermediate image
upon the image plane; and

a field optical system disposed between said first imaging optical
system and said second imaging optical system, for projecting a pupil of said first imaging
optical system onto said second imaging optical system, said field optical system including a first
field mirror unit having a first field mirror, and a second field mirror unit having a second field
mirror.

wherein a relation $0.45 < \text{LFM1}/\text{LFM2} < 0.8$ is satisfied, where LFM1 is a distance between said second field mirror and said first field mirror, and LFM 2 is a distance between said second field mirror and the image plane.

29. (Currently Amended) A projection optical system according to Claim 14 28, wherein said second field mirror group includes said second field mirror and a lens.

30. (Currently Amended) A projection optical system for projecting an image of an object onto an image plane, comprising: according to Claim 14,

a first imaging optical system for forming an intermediate image of the object, said first imaging optical system including (i) a first lens unit having a positive power, (ii) a first optical unit having a first mirror for reflecting and collecting abaxial light from the object, (iii) a second optical unit having a second mirror for reflecting light from said first mirror to the image plane side, with which the abaxial light is caused to pass an outside of an effective diameter of said first mirror, and (iv) a second lens unit having a negative power and being disposed between said first and second mirrors;

a field optical system disposed between said first imaging optical system and said second imaging optical system, for projecting a pupil of said first imaging optical system onto said second imaging optical system, said field optical system including a first field mirror unit having a first field mirror, a second field mirror unit having a second field mirror, and a field lens unit having a positive power;

wherein ~~a positive~~ the field lens unit, ~~included by said field optical system,~~ is disposed between ~~said~~ the first mirror of ~~said first imaging optical system~~ and ~~said~~ the

~~second field mirror of said field optical system, wherein light reflected by said second mirror of said first imaging optical system passes through said positive lens and then is reflected by said first field mirror.~~

31. (Original) A projection optical system according to Claim 1, wherein said projection optical system is telecentric with respect to each of the object side and the image plane side.

32. (Original) A projection optical system according to Claim 1, wherein said projection optical system has a magnification of reduction ratio.

33. (Original) A projection optical system according to Claim 1, further comprising a field stop disposed at the position of the image defined by said first imaging optical system, for changing at least one of a size and a shape of an imaging region upon the image plane.

34. (Original) A projection optical system according to Claim 1, further comprising a stop disposed inside said second imaging optical system.

35. (Previously Presented) A projection exposure apparatus for projecting a pattern of a mask onto a substrate through a projection optical system as recited in Claim 1.

36. (Original) A projection exposure apparatus according to Claim 35, wherein laser light from one of an ArF excimer laser and an F₂ excimer laser is used for the projection exposure.

37. (Previously Presented) A device manufacturing method, comprising the steps of:

printing a device pattern on a wafer by exposure, using a projection exposure apparatus as recited in Claim 35; and

developing the exposed wafer.

38. (Previously Presented) A projection optical system according to Claim 1, wherein said second imaging optical system includes two mirrors.

39. (Previously Presented) A projection optical system according to Claim 1, wherein said first and second mirrors adjoin along an optical path.

40. (Currently Amended) A projection optical system for projecting an image of an object onto an image plane, comprising:

a first imaging optical system for forming an image of the object, said first imaging optical system including a first mirror for reflecting and collecting abaxial light from the object;

a second imaging optical system for re-imaging the image upon the image plane;

a second mirror for reflecting light from said first mirror to the image plane side, whereby the abaxial light is caused to pass outside of an effective diameter of said first mirror; and

a field optical system including three lenses each having a positive refractive power,

wherein the abaxial light passed through the outside of the effective diameter of said first mirror is refracted by said three lenses toward a direction nearing an optical axis of said three lenses,

wherein light ~~emitted from~~ that has passed through said three lenses is directed to said second imaging optical system, and

wherein said first and second imaging optical systems are disposed along a common optical axis.

41. (Previously Presented) A projection optical system according to Claim 40, wherein said field optical system includes one lens having a negative refractive power.

42. (Cancelled).

43. (Previously Presented) A projection optical system according to Claim 40, wherein said first and second mirrors adjoin along an optical path.

44. (Previously Presented) A projection optical system for projecting a pattern of a mask onto a substrate through a projection optical system as recited in Claim 40.

45. (Previously Presented) A projection optical system according to Claim 44, wherein laser light from one of an ArF excimer laser and an F₂ excimer laser is used for the projection optical system.

46. (Previously Presented) A device manufacturing method, comprising the steps of:

printing a device pattern on a wafer by exposure, using a projection exposure apparatus as recited in Claim 44.

47. (New) A projection optical system for projecting an image of an object onto an image plane, comprising:

a first imaging optical system for forming an intermediate image of the object, said first imaging optical system including (k) a first lens unit having a positive power, (ii) a first optical unit having a first mirror for reflecting and collecting abaxial light from the object, (iii) a second optical unit having a second mirror for reflecting light from said first mirror to the image plane side, with which the abaxial light is caused to pass an outside of an effective diameter of said first mirror, and (iv) a second lens unit having a negative power and being disposed between said first and second mirrors;

a second imaging optical system for re-imaging the intermediate image upon the image plane, said second imaging optical system being composed of a plurality of lenses; and

a field optical system disposed between said first imaging optical system and said second imaging optical system, for projecting a pupil of said first imaging

optical system onto said second imaging optical system, said field optical system including three lenses each having a positive power;

wherein said first imaging optical system, said second imaging optical system and said field optical system are disposed along a common straight optical axis.

48. (New) A projection exposure apparatus for projecting a pattern of a mask onto a substrate through a projection optical system as recited in Claim 47.

49. (New) A device manufacturing method, comprising the steps of:
printing a device pattern on a wafer by exposure, using a projection exposure apparatus as recited in Claim 48; and
developing the exposed wafer.

50. (New) A projection optical system according to Claim 22, wherein said first imaging optical system, said second imaging optical system and said field optical systems are disposed along a common straight optical axis.

51. (New) A projection exposure apparatus for projecting a pattern of a mask onto a substrate through a projection optical system as recited in Claim 16.

52. (New) A device manufacturing method, comprising the steps of:
printing a device pattern on a wafer by exposure, using a projection exposure apparatus as recited in Claim 51; and
developing the exposed wafer.
53. (New) A projection exposure apparatus for projecting a pattern of a mask onto a substrate through a projection optical system as recited in Claim 22.
54. (New) A device manufacturing method, comprising the steps of:
printing a device pattern on a wafer by exposure, using a projection exposure apparatus as recited in Claim 53; and
developing the exposed wafer.
55. (New) A projection exposure apparatus for projecting a pattern of a mask onto a substrate through a projection optical system as recited in Claim 28.
56. (New) A device manufacturing method, comprising the steps of:
printing a device pattern on a wafer by exposure, using a projection exposure apparatus as recited in Claim 55; and
developing the exposed wafer.
57. (New) A projection exposure apparatus for projecting a pattern of a mask onto a substrate through a projection optical system as recited in claim 30.

58. (New) A device manufacturing method, comprising the steps of:
printing a device pattern on a wafer by exposure, using a projection
exposure apparatus as recited in Claim 57; and
developing the exposed wafer.